Bellows Air Force Station - Conceptual Wastewater Collection System Design (For Planning Use Only)

PREPARED FOR:

PREPARED BY:

DATE: January 20, 2004

This technical memo presents the conceptual design of the Bellows Air Force Station (AFS) wastewater collection system. This conceptual design serves to provide Hickam AFB a conceptual plan and rough order of magnitude cost for planning purposes to upgrade the existing on-site wastewater treatment system at Bellows AFS to a standard municipal wastewater collection and conveyance system. It is proposed that the wastewater collection system will connect to the Waimanalo Municipal wastewater treatment system.

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1.0 Purpose

The purpose of this draft technical memorandum is to develop a conceptual design and cost estimate for the conveyance of domestic sewage from Bellows AFS to the Kahawai Stream Sewage Pump Station in the Waimanalo Sewer District.

This conceptual design is intended for planning purposes and does not eliminate the need for a detailed engineering evaluation, coordination with the existing utilities, and detailed design including production of construction contract drawings. The conceptual plan and associated costs included in this technical memorandum will likely vary from a more detailed engineering evaluation and design because this engineering evaluation was developed using preliminary data available, without extensive surveying, geotechnical and hydrological data. Where minimal data was available, assumptions were made to complete this project, thus providing the conceptual foundation for a more detailed engineering evaluation in the future.

2.0 Assumptions

The Bellows AFS conceptual design was prepared based on the following assumptions, as well as, the assumptions outlined in Attachment 1, Bellows AFS Wastewater Collection System Conceptual Design: Estimated Flow, Proposed Collection System Route, and General Design Assumptions Technical Memorandum.

1. The Waimanalo Sewage District has the capacity and inclination to accept the additional waste load from Bellows AFS through the Kahawai Pump Station.

2. The wastewater piping route was selected based on recommendations from Hickam AFB to follow the route of the existing water lines in order to minimize the disturbance of archeological artifacts.

3. Sewage will be conveyed to the Waimanalo Wastewater Treatment Plant for treatment via the existing Kahawai Pump Station. This pump station is located at the junction of Kalanianaole Highway and Kahawai stream.

4. Groundwater is 7 feet below the ground surface and buried collection system piping will not be installed below groundwater. However the bottom of the wet wells will need to be approximately 4 to 6 feet below the incoming sewer pipe and dewatering will be required for the construction of the wet wells. Note that it is possible to excavate further down than 7 feet by dewatering construction techniques and the use of dewatering wells; however, due to the issues concerning ground water and ground contamination this was not considered.

5. For this analysis, no geotechnical data was available along the proposed pipe route. It is assumed that only sandy soil will be encountered with no significant rock, coral, or other obstacles to construction.

6. The bridge at the Waimanalo Stream crossing will be able to support and will be capable of attaching the wastewater distribution piping.

7. No hazardous materials will be encountered

3.0 Conceptual Design Summary

The Bellows AFS conceptual design provides for the conveyance of domestic sewage from seventy buildings at Bellows AFS to a sewage pump station operated by the Waimanalo Sewer District, located on the Kalanianaole Highway. This concept would eliminate the need for cesspools/septic systems that currently serve these buildings.

4.0 Basis for Conceptual Design

4.1 Existing Facilities and Problems

Seventy buildings at Bellows AFS, located along Waimanalo Bay, are included in the conceptual design. Domestic sewage from these buildings is currently disposed through septic tank/drainfield systems. The Air Force and the State of Hawaii would like to eliminate this sanitation problem and its potential contamination of Waimanalo Bay.

4.2 Service Area

The service area is located along the shore of Waimanalo Bay, north of the mouth of Waimanalo stream. The cottages and recreational facilities extend approximately one mile along the shore north of Waimanalo stream. For this conceptual design, sewage is to be conveyed by gravity and lift stations to the Kahawai Pump Station, a distance of nearly seven miles from the closest served facility.

The service area and conveyance route are shown in Attachment 3.

4.3 Current and Future Service Population

The Air Force provided an overall estimate of building occupancy for Bellows AFS (390 people). This estimate however, did not include the population for public use of some of the buildings, such as the bathhouses and public restrooms. To estimate the public use population for these buildings data was obtained from the Bellows AFS Utilities Privatization study. It was estimated that if 200,000 people use the Bellows AFS beaches each year ,then approximately 548 people per day use those public facilities. Staff at Hickam

AFB have indicated that the Air Force's mission will require very little growth at Bellows AFS. Five percent growth is assumed for the design.

4.4 Design Waste Loads

The current waste flows have been derived from standard unit flow data available in the literature. The meter readings, after initial QA/QC screening, were inconsistent and were not useable. See Attachment 2.

4.5 Design Flow Rates

Wastewater conveyance systems are typically designed to accommodate the peak hourly flow. Therefore, the hydraulic capacity of the pipes and pump stations at Bellows AFS were designed to accommodate peak hourly flow using a peaking factor that was applied to the design average flows shown in Attachment 2. The peaking factor can be calculated from the following equation[1]:

$$Q_{\text{Peak Hourly}}/Q_{\text{Design Average}} = (18 + \sqrt{P}) / (4 + \sqrt{P})$$

Where P = population in thousands

For a design population of 548, the peaking factor is 4.0.

4.6 Conceptual Design

a) Pipe Route

The pipe routing was as recommended by Hickam AFB, to follow the existing water line, in order to avoid excavation into archeologically sensitive areas. A 10-foot horizontal separation and a 1.5-foot vertically separation is typically required between water and sewer mains.

b) Geotechnical Considerations

No geotechnical data was available for this conceptual design over the proposed pipe route. Conditions were assumed to be similar to those reported near the Pier Dump Site[2] where groundwater was found 6 to 10 feet below ground surface. Further general information about soil and groundwater at Bellows AFS was gathered from existing data[3]. For this conceptual design, groundwater was assumed to be 7 feet below ground surface. It was further assumed that installation of sewer pipe would not be practicable below the groundwater table.

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[1] Recommended Standards for Wastewater Facilities, Great Lakes- Upper Mississippi River Board of State Public Health and Environmental Managers, 1990 Ed.

[2] Final Work Plan For Removal Site Evaluation at Peir Dump Site (LF24), Bellows Air Force Station, Oahu, Hawaii, Prepared for AFCEE Environmental Restoration Division, Brooks AFB, Texas by CH2M HILL, February 10, 2003

[3] Technical Memorandum: Continuous Water-Level Monitoring at Site LF01, Engineering Cost Evaluation/Cost Analysis for Operable Unit 1 (Sites LF01, DP17, SD22, and DP06), Bellows Air Force Station, Oahu, Hawaii, Prepared for AFCEE Environmental Restoration Division, Brooks AFB, Texas by CH2M HILL, June 14, 2001

Sand or silty sand was assumed to exist throughout the proposed pipe route such that no imported pipe bedding would be necessary for the sewer pipe.

c) Pipe Selection

The sandy soil in the area may be particularly corrosive due to the proximity of the ocean. For this reason and because sandy soil can provide good bedding for plastic pipe, Polyvinyl Chloride (PVC) and High Density Polyethylene (HDPE) pipe were selected as the pipe material. PVC pipe was selected as the pipe material for sewer pipe for gravity flow conditions and HDPE pipe was selected for the sewage force main. Either pipe can withstand a standard H20 wheel load if it is buried a minimum of 4 feet deep in sandy soil.

d) Lift Station Conceptual Design

The location of the proposed sewage lift stations is shown in Attachment 4. For planning purposes, these are each assumed to be duplex lift stations with two 3 horsepower pumps per station. The pumps are anticipated to be rail-guided submersible units mounded within a 6-foot diameter concrete wetwell that is approximately 10-12 feet deep. A separate 4-foot diameter 5-foot deep concrete manhole should be located adjacent to the wetwell to house the valves and cleanout. Pump controls should be located above ground in a weatherproof enclosure.

Attachments

Attachment 1 : Bellows AFS Proposed Route Technical Memorandum

Bellows AFS Wastewater Collection System Conceptual Design : Estimated Flow, Proposed Collection System Route, and General Design Assumptions

PREPARED FOR:

PREPARED BY:

DATE: December 8, 2003

This technical memo presents the basis for the conceptual design of the Bellows AFS wastewater collection system. The primary design elements are the estimated quantity of wastewater flow generated, the route of the collection system, and the general design assumptions.

Estimated Wastewater Flow

To develop the basis of flow for the wastewater collection system weekly meter data collected from several septic systems that are currently in use were reviewed, and estimates were calculated based on the usage and occupancy/public use population of buildings at Bellows AFS.

Weekly Meter Readings. The meter data alone could not be used for the following reasons:

- Weekly meter readings varied by a factor of ten to one-hundred, indicating possible reading error
- Weekly meter readings were noted in some instances to go backwards, indicating possible reverse installation of the meter or reading error

Due to these inconsistencies in the weekly meter readings the average and daily wastewater collection was found to be unreliable.

Building Usage and Occupancy/Public Use Estimates. The Air Force provided an overall estimate of building occupancy for Bellows AFS (390). This estimate however, did not include the population for public use of some of the buildings, such as the bathhouses and public restrooms. To estimate the public use population for these buildings data was obtained from the Bellows AFS Utilities Privatization study. It was estimated that if 200,000 people use the Bellows AFS beaches each year, then approximately 548 people per day use those public facilities.

A listing of buildings to be included in the Bellows AFS wastewater system was developed by the Air Force. Using this list, we prepared the spreadsheet shown in Attachment 2 to calculate the average daily flows at Bellows AFS. The usage and occupancy/public use population for each building is listed along with the high and low flows per capita for a

building of that usage. Flow data was then calculated taking into account both the high end and low end use. Based on this data the flows for Bellows AFS were estimated to be as follows:

- High end wastewater flow is: 53,074 gallons per day
- Low end wastewater flow is: 30, 860 gallons per day
- Average wastewater flow is: 41,267 gallons per day

The average wastewater flow will be used to prepare the design.

Proposed Wastewater Collection System Route

The proposed wastewater collection system route will follow the route of the existing water lines at Bellows AFS. By following the existing water line route it is anticipated that disturbance of archeological significant areas would be minimized. The estimated flow data presented above will be used to design the piping system based on the route attached in Attachment 3.

General Design Assumptions

The conceptual design will be based on the following assumptions, unless stated otherwise:

- The proposed route shall generally follow the existing water line route, allowing for a minimum separation distance of 10 feet
- HDPE is the preferred pipe material due to its resistance to corrosion
- Marker tape or tracer wire will be installed
- Electricity (3-phase) will be available for the lift stations
- There will be approximately 5% growth at Bellows AFS over the next 10 years
- Existing sewer piping and tanks will be abandoned in place; tanks will be filled with sand
- The preferred design method will be gravity flow and then pumping using lift stations, as necessary
- Easements will not be an issue
- Connection to the Waimanalo wastewater collection system will not be an issue
- Standard piping, connections, valves, and manholes will be used
- Standard lift station equipment (pumps, wells, building and controls): which shall also include high and low level alarms, fan, flow meter, emergency back-up generator, lights, and electrical panel.
- Sewage is non-industrial and does not contain fuels, contaminants or hazardous materials

- Waste constituents are typical of those found in recreational facilities and are non-industrial or commercial
- An archeologist will be required during excavation for archeological oversight
- Depth of pipe will be on average between 3 to 6 feet.
- Soil type is sandy granular soil with some silt
- It is assumed that depth to bedrock (or coral reef) is greater than the proposed pipe burial depth)
- Standard wastewater design soil loading per code

Attachment 2: Bellows AFS Flow Wastewater Collection System Flow Data

Proposed Bellows Wastewater Collection System - Flow Data

Bellow AFS, Oahu, Hawaii

Date: December 8, 2003

Flow Data				Flow Low*		Flow High*	
Building Number	Description	Occupancy	Comments	L/person/d	gallons/day	L/person/d	gallons/day
150	double dwelling cottage	7	located west of bldg 151	130	240	190	351
151	double dwelling cottage	7		130	240	190	351
152	double dwelling cottage	7		130	240	190	351
153	double dwelling cottage	7		130	240	190	351
154	double dwelling cottage	7		130	240	190	351
155	double dwelling cottage	7		130	240	190	351
156	double dwelling cottage	7		130	240	190	351
157	double dwelling cottage	7		130	240	190	351
160	double dwelling cottage	7	located west of bldg 161	130	240	190	351
161	double dwelling cottage	7	located west of bldg 162	130	240	190	351
162	double dwelling cottage	7	located west of bldg 163	130	240	190	351
163	single dwelling cottage	3.5	located west of bldg 157	130	120	190	176
201	bathhouse 1	109.6	1/5 usage population of 548	20	579	50	1,448
202	pavillion		No sewage	0	0	0	0
203	pavillion		No sewage	0	0	0	0
204	pavillion		No sewage	0	0	0	0
220	club	137	1/4 usage population of 548	250	9,049	500	18,098
222	concrete slab		No sewage	0	0	0	0
232	double dwelling cottage	7		130	240	190	351
233	double dwelling cottage	7		130	240	190	351
234	double dwelling cottage	7		130	240	190	351
235	double dwelling cottage	7		130	240	190	351
236	double dwelling cottage	7		130	240	190	351
237	double dwelling cottage	7		130	240	190	351
238	double dwelling cottage	7		130	240	190	351
239	double dwelling cottage	7		130	240	190	351
240	double dwelling cottage	7		130	240	190	351
241	double dwelling cottage	7		130	240	190	351
242	double dwelling cottage	7		130	240	190	351
243	double dwelling cottage	7		130	240	190	351
244	double dwelling cottage	7		130	240	190	351
246	double dwelling cottage	7	Per meter reading	130	240	190	351
247	double dwelling cottage	7	Per meter reading	130	240	190	351
248	double dwelling cottage	7	Per meter reading	130	240	190	351
249	double dwelling cottage	7	Per meter reading	130	240	190	351
250	bathhouse 2	109.6	1/5 usage population of 548	20	579	50	1,448
313	base exchange	10	Assumed occupancy of ten	30	79	50	132
314	bathhouse 3	109.6	1/5 usage population of 548	20	579	50	1,448
315	double dwelling cottage	7		130	240	190	351
316	double dwelling cottage	7		130	240	190	351
317	double dwelling cottage	7		130	240	190	351
318	double dwelling cottage	7		130	240	190	351
319	double dwelling cottage	7		130	240	190	351
320	double dwelling cottage	7		130	240	190	351
322	double dwelling cottage	7		130	240	190	351
323	double dwelling cottage	7		130	240	190	351
324	double dwelling cottage	7		130	240	190	351
325	double dwelling cottage	7		130	240	190	351
326	double dwelling cottage	7		130	240	190	351
327	double dwelling cottage	7		130	240	190	351
328	double dwelling cottage	7		130	240	190	351
329	double dwelling cottage	7		130	240	190	351
330	single dwelling cottage	3.5		130	120	190	176
331	single dwelling cottage	3.5		130	120	190	176
445	single dwelling cottage	3.5		130	120	190	176
446	single dwelling cottage	3.5		130	120	190	176
448	double dwelling cottage	7		130	240	190	351
449	double dwelling cottage	7		130	240	190	351
450	shed		No sewage	0	0	0	0
451	single dwelling cottage	3.5		130	120	190	176
452	single dwelling cottage	3.5	Per meter reading	130	120	190	176
453	single dwelling cottage	3.5	Per meter reading	130	120	190	176
454	single dwelling cottage	3.5	Per meter reading	130	120	190	176
455	double dwelling cottage	7		130	240	190	351
475	bathhouse 4	109.6	1/5 usage population of 548	20	579	50	1,448
476	shed		No sewage	0	0	0	0
480	Falcon -DV cottage	3.5	Occupancy based on Hickam Data	130	120	190	176
482	Eagle - DV cottage	3.5	Occupancy based on Hickam Data	130	120	190	176
506	Gymn		No sewage	0	0	0	0
508	Maid (washing machines)	6	Assume 6 machines	1,800	2,853	2,600	4,122
514			No sewage	0	0		0
515			No sewage	0	0		0
517	bathhouse 5	109.6	1/5 usage population of 548	20	579	50	1,448
520			Building demolished	0	0		0
530			Building demolished	0	0		0
532			Building demolished	0	0		0
534			Building demolished	0	0		0
540			Building demolished	0	0		0
542	Wash Rack	6	Assume equivilent of 6 machines	1,800	2,853	2,600	4,122
548			No sewage	0	0		0
572	Hale Makai	3.5	Occupancy based on Hickam Data	130	120	190	176
580	Captain's quarters	3.5	Occupancy based on Hickam Data	130	120	190	176
new	four-plex	8	Occupancy based on Hickam Data	130	275	190	402
new	four-plex	8	Occupancy based on Hickam Data	130	275	190	402
new	dormatory	10	Occupancy based on Hickam Data	75	198	175	462
			Total Flow Low/day gallons		**30,860**		
			Total Flow High/day gallons				**53,074**
			Total Average Flow gallons		**41,967**		

*** NOTES:**

Wastewater flow rates calculated from:

Wastewater Engineering Treatment Disposal and Refuse by Metcalf & Eddy, Second Edition, McGraw Hill Book Company Copywright 1979.

Attachment 3 : Bellows AFS Proposed Wastewater Collection System Proposed Route

(see separate map)

Attachment 4: Bellows AFS Proposed Wastewater Collection System Conceptual Design Drawing

(see separate map)

Attachment 5: 1391 Data Sheet for the Proposed Bellows Wastewater Collection System

Form 1391 Data Bellows for the Proposed AFS Wastewater Collection System

Project Title: Install Sanitary Sewer Collection System, Bellows AFS

System: Wastewater

Suggested Fiscal Year: 2005

Deficiency Description:

Upgrade the existing on-site wastewater treatment system at Bellows AFS to a standard municipal wastewater collection and conveyance system connecting to the Waimanalo Municipal wastewater treatment system. The current system consists of multiple Class V Injection Wells involving Large-Capacity Cesspools, as defined by the State of Hawaii, and multiple standard individual and community sized on-site septic tank drainfield systems. The current system has exceeded its design life and is no longer an acceptable means for treating wastewater. The current system will not meet future EPA requirements for the area.

Description of Proposed Remedy:

The project involves abandoning the existing wastewater collection system and the design and construction of a standard wastewater collection and conveyance system consisting of approximately 21,350 linear feet of pipe and approximately 9 sewage lift stations. Average depth to bury is 6 feet.

Impact If Not Provided:

The current method of on-site treatment will not meet future EPA requirements. If such requirements are not met the installation would possibly face fines and the future expense of meeting the EPA requirements.

In addition the design life of certain portions of the piping at Bellows has been exceeded. If it is not replaced, the system and/or pipe could fail and cause the buildings to be without sanitary sewer service. Hickam AFB would incur the expense of repairing the septic system/pipe in an emergency situation. In addition, raw sewage is a health hazard and the Base could receive a notice of violation from the Hawaii Department of Public Health and Environment and potentially be fined.

Relationship to Other Projects:

Promoting ongoing Base-wide infrastructure maintenance and repair should be a priority. This work influences other Base projects by demonstrating a commitment to Hickam AFB's infrastructure.

Project Source:

Project requirements were developed by conducting base interviews, reviewing the current wastewater system conditions, reviewing the current system inventory and drawings and reviewing standards of the industry for municipal wastewater collection systems.